

Forecast Comparisons

The *AEO2004* forecast period extends through 2025. One other organization—Global Insight, Incorporated (GII)—produces a comprehensive energy projection with a similar time horizon. Several others provide forecasts that address one or more aspects of energy markets over different time horizons. Recent projections from GII and others are compared here with the *AEO2004* projections.

Economic Growth

From 2002 to 2025, the projected growth in gross domestic product (GDP), based on 1996 chain-weighted dollars, is 3.0 percent per year. This projected growth is slightly lower than the 3.1-percent average annual growth projected in *AEO2003* (Table 27). The *AEO2004* forecast was based on the August 2003 long-range forecast of GII, modified to reflect EIA's view on world oil prices.

Through 2008, the *AEO2004* forecast of 3.3-percent average annual growth in GDP is similar to other forecasts: the GII forecast is 3.3 percent, the same as the November 2003 forecast by Oxford Economic Forecasting (OEF), and both the July 2003 forecast by the Office of Management and Budget (OMB) and the August 2003 forecast by the Congressional Budget Office (CBO) show 3.2-percent average annual growth through 2008. From 2002 through 2013, the *AEO2004*, GII, and OEF forecasts show 3.2-percent growth per year, while the CBO forecast is 3.0 percent per year. From 2002 to 2025, the GII forecast shows 3.0-percent average annual growth in GDP. The range of average annual economic growth rates around the *AEO2004* reference case is from 2.4 percent in the low economic growth case to 3.5 percent in the high economic growth case.

World Oil Prices

Comparisons with other oil price forecasts—including GII, the International Energy Agency (IEA), Petroleum Economics, Ltd. (PEL), Petroleum Industry Research Associates, Inc. (PIRA), Natural Resources Canada (NRCan), Deutsche Bank A.G. (DB), Energy and Environmental Analysis, Inc. (EEA), National Petroleum Council (NPC), Strategic Energy & Economic Research, Inc. (SEER), and Centre for Global Energy Studies (CGES)—are shown in Table 28 (GII, Spring-Summer 2003; IEA, September 2002; PEL, April 2003; PIRA, October 2003; NRCan, 1997, reaffirmed in September 2002; DB, September 2003; EEA, October 2003; NPC, October 2003; SEER, November 2003; CGES, January 2003). The world oil price measure varies by forecast. In some it is the spot

price for West Texas Intermediate (WTI), Brent, or a basket of crude oils. *AEO2004* uses the composite U.S. refiners' acquisition cost of crude oil, including transportation and fees. There is no simple way to put the forecasts for oil prices (Table 28) on a common basis. With the exception of PEL and CGES, which fall below the *AEO2004* low world oil price case in 2020, the range between the *AEO2004* low and high world oil price cases spans the range of published forecasts.

Total Energy Consumption

The *AEO2004* forecast of end-use sector energy consumption shows higher growth for petroleum and natural gas than occurred between 1980 and 2002, and growth in projected electricity consumption is only slightly less (1.8 percent compared to 1.9 percent) (Table 29). Much of the projected growth in petroleum consumption is driven by increased

Table 27. Forecasts of annual average economic growth, 2002-2025

Forecast	Average annual percentage growth		
	2002-2008	2002-2013	2002-2025
<i>AEO2003</i>	3.2	3.3	3.1
<i>AEO2004</i>			
Reference	3.3	3.2	3.0
Low growth	2.8	2.7	2.4
High growth	4.0	3.8	3.5
GII	3.3	3.2	3.0
OMB	3.2	NA	NA
CBO	3.2	3.0	NA
OEF	3.3	3.2	NA

NA = not available.

Table 28. Forecasts of world oil prices, 2005-2025 (2002 dollars per barrel)

Forecast	2005	2010	2015	2020	2025
<i>AEO2003</i>	23.57	24.28	25.01	25.77	26.89
<i>AEO2004</i>					
Reference	23.30	24.17	25.07	26.02	27.00
High price	31.16	33.27	34.23	34.63	35.03
Low price	16.98	16.98	16.98	16.98	16.98
GII	21.77	21.95	24.03	25.68	27.06
IEA	21.75	21.75	23.82	25.89	27.96
PEL	20.96	21.27	18.41	15.60	NA
PIRA	23.80	23.90	26.70	N/A	NA
NRCan	22.57	22.57	22.57	22.57	NA
DB	18.13	18.03	18.41	18.16	18.26
EEA	20.99	20.33	19.84	19.36	NA
NPC	18.00	18.00	18.00	18.00	18.00
SEER	21.08	19.86	20.88	22.49	24.53
CGES	23.82	21.27	18.41	15.60	NA

NA = not available.

demand in the industrial sector for petrochemical and manufacturing applications as economic activity expands, and in the transportation sector as improvements in efficiency are unable to offset increases in miles traveled. Natural gas consumption is expected to increase in the residential, commercial, and industrial sectors as environmental and economic pressures benefit natural gas at the expense of petroleum and coal consumption. Coal consumption in those end-use sectors is expected to decline slightly as a result of increased fuel switching and growing concern about emissions.

Electricity is expected to remain the fastest growing source of delivered energy (although not outpacing historical growth rates), because many traditional uses of electricity (such as for air conditioning) approach saturation while average equipment efficiencies rise. The *AEO2004* projections are generally consistent with the outlook from GII; however, GII forecasts slower growth in natural gas consumption and electricity losses as well as slightly faster growth in petroleum consumption, resulting from differences in relative prices and projected growth in each sector.

Electricity

The *AEO2004* electricity forecast assumes that wholesale markets in most U.S. regions will be restructured, resulting in average wholesale electricity prices that approach long-run marginal costs. The same cannot be said for retail markets at the State level: as of 2003, only 17 States and the District of Columbia had competitive retail markets in operation. Further, a number of States have delayed opening competitive retail markets, Arkansas has repealed retail restructuring, and California has suspended restructuring. The *AEO2004* forecast

assumes that no additional retail markets will be restructured, but that the partial restructuring (particularly in wholesale markets) will lead to increased competition in the electric power industry, lower operating and maintenance costs, lower general and administrative costs, early retirement of inefficient generating units, and other cost reductions.

Comparison across the *AEO2004*, GII, and EEA forecasts shows slight variation in projected electricity sales (Table 30). The forecasts for total electricity sales in 2025 range from 4,861 billion kilowatthours in the *AEO2004* low economic growth case to 5,527 billion kilowatthours in the *AEO2004* high economic growth case. The *AEO2004* reference case projection of 5,207 billion kilowatthours is framed by the GII forecast (5,072) and the Energy Ventures Analysis (EVA) forecast (5,341), with the SEER forecast at 5,319 billion kilowatthours. Demand growth rates range from 1.7 percent in the GII forecast to 1.8 percent in the *AEO2004* reference case and 2.1 percent in the *AEO2004* high economic growth case. All price forecasts reflect competition in wholesale markets and slow growth in electricity demand relative to GDP growth, exerting downward pressure on real electricity prices through 2025. Rising natural gas prices balance some of the downward pressure and tend to push electricity prices up in the later years of the forecasts.

AEO2004 projects a slight decline in real electricity prices over the full period of the forecast, although average prices increase slightly during the last several years as capacity margins tighten and natural gas prices climb. In contrast, GII projects a decline over the second half of the forecast as lower natural gas prices to generators (\$4.03 per quadrillion Btu in GII compared with \$4.92 per quadrillion Btu in *AEO2004* in 2025) contribute to a decline in average electricity prices from 7.1 cents per kilowatthour in 2010 and 2015 to 6.9 cents per kilowatthour in 2025 in the GII forecast. EVA, providing the only other price forecast, projects steady electricity prices over the forecast period.

Both *AEO2004* and GII incorporate large amounts of planned capacity in the short term, with *AEO2004* projecting about 53 gigawatts through 2004 and GII projecting about 75 gigawatts, virtually all of which is expected to be gas-fired. These two forecasts project a glut of capacity with falling prices in the near term, along with steady capacity margins that begin to erode only in the later years.

Table 29. Forecasts of average annual growth rates for energy consumption, 2002-2025 (percent)

Energy use	History	Projections	
	1980-2002	<i>AEO2004</i>	GII
Petroleum*	1.0	1.6	1.8
Natural gas*	0.7	1.3	0.8
Coal*	-1.4	-0.3	-0.4
Electricity	1.9	1.8	1.7
Delivered energy	0.9	1.5	1.5
Electricity losses	1.7	1.3	0.7
Primary energy	1.1	1.5	1.3

*Excludes consumption by electricity generators in the electric power sector but includes consumption for end-use combined heat and power generation.

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All five forecasts project that demand will grow fastest in the commercial sector and that more cycling and baseload capability will be built than peaking units. All the forecasts except EVA show significant net additions to coal-fired capacity: 101 gigawatts by 2025 in *AEO2004*, 57 gigawatts in the EEA forecast by 2020, and 130 gigawatts in the GII forecast by 2025. GII projects 2.5 gigawatts of nuclear retirements, more than *AEO2004*, which projects no retirements and 3.9 gigawatts of expansion through uprating of existing capacity.

The EVA forecast of fuel-mix proportions differs substantially from *AEO2004* and the other forecasts. Whereas all the other forecasts project that coal will provide about one-half and natural gas about one-quarter of electricity generation throughout the period, EVA projects much greater reliance on natural gas by 2025. The EVA forecast assumes that legislation similar to Clear Skies—including further restrictions on sulfur dioxide (SO₂), nitrogen oxides (NO_x), and mercury emissions—will be in effect by 2010. The EVA forecast also includes a \$5 per ton tax on carbon dioxide emissions beginning in 2013. This combination (further environmental restrictions and a tax on carbon dioxide) allows for only marginal growth in coal-fired generation, with natural gas making up the shortfall (natural-gas- and coal-fired generation are nearly equal by 2025). Natural gas prices, and consequently electricity prices, are held in check by large gains in the efficiency of natural gas combined-cycle capacity.

Natural Gas

The differences among published forecasts of natural gas prices, production, consumption, and imports (Table 31) indicate the uncertainty of future market trends. Because the forecasts depend heavily on the underlying assumptions that shape them, the assumptions made in each forecast should be considered when different projections are compared.

The *AEO2004* reference case is within the range of projections for total natural gas consumption in the other forecasts throughout the forecast period. The lowest projected totals for natural gas consumption are from the NPC Balanced Future scenario, and the highest are from the EVA forecast. For residential and commercial natural gas consumption, DB projects the largest growth. The lowest consumption levels for these sectors are generally projected by GII or PIRA. The *AEO2004* reference case projections fall in

the middle of the range for residential consumption and toward the low end for commercial consumption. Natural gas consumption in the industrial and electric power sectors is more difficult to compare, given potential definitional differences. The EVA forecast shows the fastest growth in natural gas consumption in combined totals for the industrial and electric power sectors, whereas the NPC Reactive Path and Balanced Future scenarios and the DB forecast show much slower growth than the other forecasts.

Domestic natural gas consumption is met by domestic production and net imports. All forecasts show domestic production providing a decreasing share of total natural gas supply, with *AEO2004* and both NPC cases showing a smaller shift in that direction and significantly lower net imports. The two NPC cases generally project the lowest levels of pipeline and liquefied natural gas (LNG) imports, with the highest levels projected by EVA for both sources. Only EVA and GII project pipeline imports higher in 2025 than they are today; the NPC Balanced Future scenario projects pipeline imports in 2025 at less than one-third of current volumes. PIRA and EVA, as well as GII and DB in 2025, show net imports as providing a notably higher share of total supply than in the other forecasts.

Wellhead natural gas price projections in the *AEO2004* reference case are higher than in the other available forecasts (not all forecasts provide wellhead price projections), with the exception of EEA. Of the three forecasts that project end-use prices (*AEO2004*, GII, and EEA), *AEO2004* shows the highest end-use-to-wellhead margins for the electric power sector and the lowest end-use-to-wellhead margins for the industrial sector. For the residential and commercial sectors, the projected margins in *AEO2004* fall in the middle range of the available forecasts. Margins are notably lower for the residential and commercial sectors in the EEA forecast and for the electric power sector in the GII forecast (some of the differences may reflect definitional variations).

Petroleum

The GII, DB, and PIRA forecasts of world oil prices and domestic petroleum production, consumption, and imports can be compared with the *AEO2004* reference, low world oil price, and high world oil price cases (Table 32). The *AEO2004* reference case projects a world oil price of \$25.07 per barrel (2002 dollars) in 2015, compared with projections from GII at

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Table 30. Comparison of electricity forecasts, 2015 and 2025 (billion kilowatthours, except where noted)

Projection	2002	AEO2004			Other forecasts			
		Reference	Low economic growth	High economic growth	GII	EVA	EEA	SEER
2015								
Average end-use price (2002 cents per kilowatthour)	7.2	6.8	6.5	7.2	7.1	6.8	NA	NA
Residential	8.4	8.1	7.7	8.6	8.3	8.2	NA	NA
Commercial	7.8	7.2	6.8	7.6	7.6	7.5	NA	NA
Industrial	5.0	4.7	4.4	5.0	4.7	4.4	NA	NA
Net energy for load, including CHP	3,851	4,936	4,754	5,109	4,766	5,118	4,889	4,976
Coal	1,928	2,373	2,331	2,376	2,281	2,083	2,268	2,403
Oil	88	122	105	142	50	20	115	60
Natural gas ^a	687	1,120	1,013	1,258	1,162	1,627	1,264	1,221
Nuclear	780	812	812	812	783	827	765	801
Hydroelectric/other ^b	346	477	465	485	460	534	397	467
Nonutility sales to grid ^c	27	63	54	74	NA	NA	41	NA
Net imports	22	32	28	36	30	27	38	24
Electricity sales	3,492	4,429	4,263	4,583	4,289	4,534	4,405	4,470
Residential	1,268	1,531	1,515	1,546	1,557	1,659	1,557	1,555
Commercial/other ^d	1,230	1,682	1,663	1,701	1,582	1,685	1,584	1,650
Industrial	994	1,216	1,086	1,335	1,151	1,190	1,263	1,265
Capability, including CHP (gigawatts)^e	921	1,037	1,006	1,067	997	1,046	1,049	NA
Coal	315	326	323	325	357	300	339	NA
Oil and natural gas	390	480	454	509	400	375	478	NA
Nuclear	99	102	102	102	98	102	95	NA
Hydroelectric/other	117	130	128	131	142	269 ^f	137	NA
2025								
Average end-use price (2002 cents per kilowatthour)	7.2	6.9	6.6	7.3	6.9	6.8	NA	NA
Residential	8.4	8.1	7.6	8.8	8.1	8.2	NA	NA
Commercial	7.8	7.3	6.9	7.8	7.5	7.4	NA	NA
Industrial	5.0	4.8	4.5	5.1	4.5	4.3	NA	NA
Net energy for load, including CHP	3,851	5,794	5,408	6,159	5,630	6,080	NA	5,797
Coal	1,928	3,029	2,735	3,169	2,911	2,320	NA	3,044
Oil	88	97	103	105	26	22	NA	64
Natural gas ^a	687	1,317	1,249	1,457	1,410	2,278	NA	1,457
Nuclear	780	816	816	816	785	841	NA	754
Hydroelectric/other ^b	346	527	498	604	473	593	NA	462
Nonutility sales to grid ^c	27	95	72	120	NA	NA	NA	NA
Net imports	22	8	7	8	24	26	NA	16
Electricity sales	3,492	5,207	4,861	5,527	5,072	5,341	NA	5,319
Residential	1,268	1,747	1,686	1,781	1,840	1,986	NA	1,747
Commercial/other ^d	1,230	2,038	1,967	2,095	1,883	2,037	NA	2,100
Industrial	994	1,422	1,207	1,650	1,350	1,317	NA	1,472
Capability, including CHP (gigawatts)^e	921	1,217	1,149	1,291	1,164	1,168	NA	NA
Coal	315	416	377	432	444	329	NA	NA
Oil and natural gas	390	557	536	598	476	452	NA	NA
Nuclear	99	103	103	103	98	104	NA	NA
Hydroelectric/other	117	141	134	159	146	283 ^f	NA	NA

^aIncludes supplemental gaseous fuels. ^b“Other” includes conventional hydroelectric, pumped storage, geothermal, wood, wood waste, municipal waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. ^cFor AEO2004, includes only net sales from combined heat and power plants. ^d“Other” includes sales of electricity to government, railways, and street lighting authorities. ^eEIA capacity is net summer capability, including combined heat and power plants. GII capacity is nameplate, excluding cogeneration plants. ^fEVA “other” includes all CHP.

CHP = combined heat and power. NA = not available.

Sources: **AEO2004**: AEO2004 National Energy Modeling System, runs AEO2004.D101703E (reference case), LM2004.D101703A (low economic growth case), and HM2004.D101703A (high economic growth case). **GII**: Global Insight, Inc., *Spring/Summer 2003 U.S. Energy Outlook* (July 2002). **EVA**: Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (July 2003). **EEA**: Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2003). **SEER**: Strategic Energy and Economic Research, Inc., *2003 Energy Outlook* (May 2003).

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Table 31. Comparison of natural gas forecasts, 2015 and 2025 (trillion cubic feet, except where noted)

Projection	2002	AEO2004 Reference	Other forecasts						
			GII ^a	EEA ^b	NPC Reactive Path	NPC Balanced Future	EVA	PIRA	DB
2015									
Lower 48 wellhead price (2002 dollars per thousand cubic feet)	2.95	4.19	3.62	4.25	NA	NA	3.44	3.74^c	3.03
Dry gas production^d	19.05	21.62	20.80	21.86	21.55	21.18	21.66^e	17.89	20.59
Net imports	3.49	6.24	7.01	6.76	5.11	5.12	9.68^f	8.58	6.67
Pipeline	3.33	3.02	3.65	3.92	2.61	1.94	4.78 ^f	3.84	NA
LNG	0.17	3.22	3.36 ^g	3.70	2.51	3.18	4.90	4.75	NA
Consumption	22.78	28.03	27.88	28.32	26.67	26.30	31.11	26.58	26.78
Residential	4.92	5.68	5.41	5.83	5.75	5.48	5.58	5.06	5.97
Commercial	3.12	3.62	3.35	3.97	3.77	3.80	3.77	3.41	4.06
Industrial ^h	7.23	8.87	8.53 ⁱ	7.70 ^j	7.21	7.41	7.67 ^k	6.53 ^l	8.31
Electricity generators ^m	5.55	7.64	8.62 ⁿ	8.89 ^o	7.77	7.48	11.73	9.38 ^p	6.45
Other ^q	1.96	2.22	1.98	1.94	2.16	2.12	2.36 ^r	2.20	2.00
End-use prices (2002 dollars per thousand cubic feet)									
Residential	7.86	8.52	8.37	7.66	NA	NA	NA	NA	NA
Commercial	6.55	7.52	7.20	6.88	NA	NA	NA	NA	NA
Industrial ^h	3.85	4.94	4.86 ^s	5.26	NA	NA	NA	NA	NA
Electricity generators ^m	3.85	4.87	4.01	4.88	NA	NA	NA	NA	NA
2025									
Lower 48 wellhead price (2002 dollars per thousand cubic feet)	2.95	4.40	3.76	NA	NA	NA	3.69	NA	3.02
Dry gas production^d	19.05	23.99	20.76	NA	20.90	20.83	24.26^e	NA	19.04
Net imports	3.49	7.24	9.91	NA	6.31	5.80	11.72^f	NA	11.16
Pipeline	3.33	2.44	3.61	NA	2.44	1.03	5.26 ^f	NA	NA
LNG	0.17	4.80	6.30 ^g	NA	3.88	4.77	6.46	NA	NA
Consumption	22.78	31.41	30.75	NA	27.62	26.62	35.89	NA	29.66
Residential	4.92	6.09	5.87	NA	6.17	5.82	5.94	NA	6.66
Commercial	3.12	4.04	3.62	NA	4.09	4.18	4.16	NA	4.78
Industrial ^h	7.23	10.29	9.35 ⁱ	NA	7.10	7.38	8.57 ^k	NA	9.18
Electricity generators ^m	5.55	8.39	9.83 ⁿ	NA	8.18	7.24	14.50	NA	6.78
Other ^q	1.96	2.59	2.08	NA	2.08	2.01	2.72 ^r	NA	2.27
End-use prices (2002 dollars per thousand cubic feet)									
Residential	7.86	8.56	8.33	NA	NA	NA	NA	NA	NA
Commercial	6.55	7.62	7.17	NA	NA	NA	NA	NA	NA
Industrial ^h	3.85	5.13	4.94 ^r	NA	NA	NA	NA	NA	NA
Electricity generators ^m	3.85	5.01	4.13	NA	NA	NA	NA	NA	NA

NA = not available.

^aConversion factor: 1,000 cubic feet = 1.026 million Btu. ^bThe EEA projection shows a cyclical price trend; forecast values for an isolated year may be misleading. ^cHenry Hub daily cash natural gas price in 2002 dollars per million Btu. ^dDoes not include supplemental fuels. ^eIncludes supplemental fuels. ^fGross imports to the Lower 48. ^gNet LNG imports equal LNG imports minus exports of 0.065 trillion cubic feet. ^hIncludes consumption for combined heat and power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public; excludes consumption by nonutility generators. ⁱExcludes gas used in cogeneration or other nonutility generation. ^jIncludes natural gas consumed in cogeneration. ^kIncludes transportation fuel consumed in natural gas vehicles. ^lExcludes gas demand for nonutility generation. ^mIncludes consumption of energy by electricity-only and CHP plants; includes small power producers and exempt wholesale generators. ⁿIncludes gas used in cogeneration or other nonutility generation. ^oIncludes independent power producers and excludes cogenerators. ^pEquals the sum of gas demand for nonutility generation plus gas demand for utility generation. ^qIncludes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles. ^rIncludes lease, plant, and pipeline fuel. ^sOn system sales or system gas (i.e., does not include gas delivered for the account of others).

Sources: **2002 and AEO2004:** AEO2004 National Energy Modeling System, runs AEO2004.D101703E (reference case). **GII:** Global Insight, Inc., *Spring/Summer 2003 U.S. Energy Outlook* (July 2002). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2003). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (July 2003). **NPC:** National Petroleum Council, *Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy*, Volume I, Summary of Findings and Recommendations (Washington, DC, September 2003), web site www.npc.org/NG_Volume_1.pdf. **PIRA:** PIRA Energy Group (October 2003). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 3, 2003.

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Table 32. Comparison of petroleum forecasts, 2015, 2020, and 2025 (million barrels per day, except where noted)

Projection	2002	AEO2004			Other forecasts		
		Reference	Low world oil price	High world oil price	GII	DB	PIRA
2015							
World oil price (2002 dollars per barrel)	23.68	25.07	16.98	34.23	24.03	18.41	26.70^a
Crude oil and NGL production	7.50	7.84	7.38	8.25	7.82	7.37	6.82
Crude oil	5.63	5.53	5.25	5.87	5.48	5.43	4.59
Natural gas liquids	1.88	2.31	2.13	2.38	2.34	1.94	2.23
Total net imports	10.54	15.52	17.54	12.79	15.89	15.11	15.52
Crude oil	9.13	13.47	14.51	11.24	10.72	NA	12.98
Petroleum products	1.41	2.05	3.03	1.55	5.18	NA	2.54
Petroleum demand	19.61	24.80	26.42	22.49	24.97	24.07	23.45
Motor gasoline	8.86	11.51	11.99	10.00	11.32	10.74	9.45
Jet fuel	1.61	2.10	2.11	2.07	2.44	1.98	2.35
Distillate fuel	3.68	4.94	5.67	4.65	4.56	4.75	4.65 ^b
Residual fuel	0.74	0.77	0.97	0.62	0.52	0.85	0.69
Kerosene	0.04	0.07	0.08	0.07	0.04	NA	NA
Liquefied petroleum gas	2.17	2.47	2.58	2.40	2.43	NA	NA
Other	2.51	2.94	3.03	2.68	3.66 ^c	5.76	6.32
Import share of product supplied (percent)	53.80	62.60	66.40	56.90	63.60	62.80	66.00
2020							
World oil price (2002 dollars per barrel)	23.68	26.02	16.98	34.63	25.68	18.16	NA
Crude oil and NGL production	7.50	7.43	6.76	8.06	7.75	6.05	NA
Crude oil	5.63	4.95	4.51	5.48	5.36	4.20	NA
Natural gas liquids	1.88	2.48	2.25	2.58	2.39	1.85	NA
Total net imports	10.54	17.49	20.33	14.62	17.94	18.28	NA
Crude oil	9.13	14.50	16.40	12.77	11.29	NA	NA
Petroleum products	1.41	2.99	3.93	1.85	6.65	NA	NA
Petroleum demand	19.61	26.41	28.66	24.26	26.99	25.99	NA
Motor gasoline	8.86	12.30	12.92	10.96	12.20	11.57	NA
Jet fuel	1.61	2.27	2.27	2.19	2.80	2.16	NA
Distillate fuel	3.68	5.24	6.33	5.00	4.80	5.12	NA
Residual fuel	0.74	0.77	1.00	0.63	0.45	0.89	NA
Kerosene	0.04	0.07	0.07	0.07	0.04	NA	NA
Liquefied petroleum gas	2.17	2.64	2.74	2.56	2.53	NA	NA
Other	2.51	3.12	3.33	2.85	4.18 ^c	6.26	NA
Import share of product supplied (percent)	53.80	66.20	70.90	60.30	66.50	70.30	NA
2025							
World oil price (2002 dollars per barrel)	23.68	27.00	16.98	35.03	27.06	18.26	NA
Crude oil and NGL production	7.50	7.08	6.25	7.41	7.69	5.01	NA
Crude oil	5.63	4.61	4.02	4.85	5.24	3.25	NA
Natural gas liquids	1.88	2.47	2.24	2.55	2.46	1.76	NA
Total net imports	10.54	19.68	23.28	16.56	19.94	21.32	NA
Crude oil	9.13	15.74	18.21	14.34	11.87	NA	NA
Petroleum products	1.41	3.94	5.07	2.22	8.07	NA	NA
Petroleum demand	19.61	28.30	31.20	25.63	28.96	28.07	NA
Motor gasoline	8.86	13.30	14.12	11.53	12.86	12.46	NA
Jet fuel	1.61	2.37	2.40	2.27	3.16	2.35	NA
Distillate fuel	3.68	5.71	7.11	5.41	5.02	5.51	NA
Residual fuel	0.74	0.75	1.02	0.64	0.45	0.93	NA
Kerosene	0.04	0.07	0.07	0.06	0.04	NA	NA
Liquefied petroleum gas	2.17	2.79	2.91	2.68	2.62	NA	NA
Other	2.51	3.30	3.58	3.05	4.81 ^c	6.82	NA
Import share of product supplied (percent)	53.80	69.50	74.60	64.60	68.90	75.90	NA

NA = Not available.

Notes: ^aWTI at Cushing, Oklahoma. ^bIncludes kerosene. ^cGII "other" petroleum demand total does not include kerosene, which is reported separately in GII's forecast.

Sources: **AEO2004**: AEO2004 National Energy Modeling System, runs AEO2004.D101703E (reference case), LW2004.D101703B (low world oil price case), and HW2004.D101703B (high world oil price case). **GII**: Global Insight, Inc., *Spring/Summer 2003 U.S. Energy Outlook* (July 2003). **DB**: Deutsche Bank AG, "World Oil Supply and Demand Estimates," e-mail from Adam Sieminski, November 3, 2003. **PIRA**: PIRA Energy Group (October 2003).

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\$24.08 per barrel, DB at \$18.41 per barrel, and PIRA at \$26.70 per barrel. PIRA's higher projection, however, does not compare directly with the other forecasts, because its pricing point (West Texas Intermediate at Cushing, Oklahoma) differs from those in the other forecasts (refiners' acquisition cost of imported crude oil) and tends to be higher.

The *AEO2004* reference case and GII price projections for 2020 and 2025 are also in a similar range, with the DB projections being significantly lower. The PIRA oil price forecast extends only to 2015. The *AEO2004* reference case and GII projections for 2025 are almost identical, but DB's projection is nearly \$4.00 per barrel lower. The DB price forecast is more in line with the *AEO2004* low price case forecast of \$16.98 per barrel throughout the forecast period. DB's oil price projections follow from the lower expected product demand than in the *AEO2004* reference case, especially for gasoline. GII's oil price projections follow from lower crude oil costs.

The *AEO2004* reference case and GII project domestic crude oil and natural gas liquids (NGL) production of about 7.8 million barrels per day in 2015. All other forecasts, except the *AEO2004* high world oil price case, are more pessimistic about U.S. production in 2015. DB and PIRA are below even the *AEO2004* low world oil price case, by 10,000 barrels per day and 560,000 barrels per day, respectively.

GII is more optimistic about domestic crude oil and NGL production in 2025 than are DB and *AEO2004*. GII's projection is 280,000 barrels per day above the *AEO2004* high world oil price case. DB is at the opposite end of the spectrum, projecting production at 1.24 million barrels per day below the *AEO2004* low world oil price case and 2.40 million barrels per day below the *AEO2004* high world oil price case.

All the forecasts project that imports will meet more than one-half of expected petroleum product demand in 2015. Both the *AEO2004* reference case and PIRA project net imports of crude oil and petroleum products at 15.52 million barrels per day in 2015. GII's projection is 370,000 barrels per day higher than those two forecasts, and DB's projection is 410,000 barrels per day lower. When imports are considered as a percentage of demand, a slightly different pattern emerges. Although DB's projected quantity of imports is below the *AEO2004* reference case, its import share of product supplied is slightly higher (0.2 percent), because DB projects lower overall

product demand in 2015. The *AEO2004* high world oil price and low world oil price cases project the lowest and highest import shares, respectively.

The forecasts project that imports will be needed to meet approximately two-thirds or more of product demand in 2025. GII projects 260,000 barrels per day more and DB projects 1.64 million barrels per day more than the *AEO2004* reference case projection. In 2025, GII projects a higher volume of both imports and product demand than the *AEO2004* reference case, with a lower share of imports needed to meet product demand. The *AEO2004* high world oil price case projects the lowest share of imports in 2025, at 64.6 percent, and DB projects the highest share at 75.9 percent (1.3 percent above the *AEO2004* low world oil price case).

GII expects slower expansion of domestic refinery capacity than do the other forecasts and, therefore, projects larger quantities of petroleum product imports and correspondingly lower crude oil imports. GII projects petroleum product imports 2.15 million barrels per day above the *AEO2004* low world oil price case projection of 3.03 million barrels per day in 2015, and 3.00 million barrels per day above the *AEO2004* low world oil price case of 5.07 million barrels per day in 2025.

GII projects higher levels of total petroleum demand in 2015, 2020, and 2025 than the *AEO2004* reference case and a different product slate, with higher levels of jet fuel demand and lower levels of demand for gasoline, distillate, and residual fuel. GII expects more growth in air travel than do the other forecasts. While the DB forecast generally projects lower levels of petroleum demand in total and by product than do the *AEO2004* and GII forecasts, it includes higher levels of demand for residual fuel oil in 2015, 2020, and 2025. The *AEO2004* low world oil price case projects the highest amounts of gasoline, distillate, and residual fuel demand in 2015, 2020, and 2025. PIRA projects the lowest level of gasoline demand in 2015, 550,000 barrels per day below the *AEO2004* high world oil price case. The *AEO2004* high world oil price case projects the lowest level of gasoline demand in 2025.

Coal

The unknown factors affecting the future of the coal industry, including the continued uncertainty of pending environmental regulations, are evident when the *AEO2004* forecast is compared against those of

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Table 33. Comparison of coal forecasts, 2015, 2020, and 2025 (million short tons, except where noted)

Projection	2002	AEO2004			Other forecasts	
		Reference	Low economic growth	High economic growth	EVA	Hill & Associates
2015						
Production	1,105	1,285	1,262	1,288	1,114	1,204
Consumption by sector						
Electricity generation	976	1,200	1,180	1,200	1,042	1,144
Coking plants	23	21	21	21	18	18
Industrial/other	67	70	67	73	60	62
Total	1,066	1,291	1,269	1,295	1,120	1,224
Net coal exports	22.7	-6.1	-6.1	-6.1	-6.2	-20.4
Exports	39.6	31.6	31.6	31.6	29.5	28.4
Imports	16.9	37.7	37.7	37.7	35.7	48.8
Minemouth price						
(2002 dollars per short ton)	17.90	16.47	15.84	16.75	17.02 ^a	17.78 ^{b,c}
(2002 dollars per million Btu)	0.87	0.81	0.78	0.82	0.83 ^a	0.81 ^{b,c}
Average delivered price to electricity generators						
(2002 dollars per short ton)	25.96	24.34	23.17	25.10	NA	21.82 ^c
(2002 dollars per million Btu)	1.26	1.22	1.16	1.25	NA	1.08 ^c
2020						
Production	1,105	1,377	1,337	1,382	1,159	1,208
Consumption by sector						
Electricity generation	976	1,301	1,263	1,305	1,095	1,158
Coking plants	23	19	19	19	17	17
Industrial/other	67	71	68	75	57	59
Total	1,066	1,391	1,349	1,399	1,169	1,234
Net coal exports	22.7	-14.4	-12.2	-15.7	-10.4	-25.6
Exports	39.6	27.4	29.5	26.0	29.7	22.6
Imports	16.9	41.7	41.7	41.7	40.1	48.2
Minemouth price						
(2002 dollars per short ton)	17.90	16.32	15.78	16.92	16.91 ^a	16.94 ^{b,c}
(2002 dollars per million Btu)	0.87	0.80	0.78	0.83	0.83 ^a	0.77 ^{b,c}
Average delivered price to electricity generators						
(2002 dollars per short ton)	25.96	24.01	22.87	25.03	NA	21.08 ^c
(2002 dollars per million Btu)	1.26	1.20	1.15	1.24	NA	1.04 ^c
2025						
Production	1,105	1,543	1,420	1,586	1,237	NA
Consumption by sector						
Electricity generation	976	1,477	1,355	1,510	1,184	NA
Coking plants	23	17	17	17	16	NA
Industrial/other	67	72	68	84	55	NA
Total	1,066	1,567	1,441	1,612	1,254	NA
Net coal exports	22.7	-22.7	-19.8	-24.8	-17.8	NA
Exports	39.6	23.0	26.0	21.0	30.0	NA
Imports	16.9	45.7	45.7	45.7	47.8	NA
Minemouth price						
(2002 dollars per short ton)	17.90	16.57	15.67	17.95	16.97 ^a	NA
(2002 dollars per million Btu)	0.87	0.82	0.78	0.88	0.84 ^a	NA
Average delivered price to electricity generators						
(2002 dollars per short ton)	25.96	24.31	22.75	26.29	NA	NA
(2002 dollars per million Btu)	1.26	1.22	1.14	1.30	NA	NA

^aThe average coal price is a weighted average of the projected spot market FOB mine price for all domestic coal.

^bThe minemouth price represents an average for domestic steam coal only. Exports and coking coal are not included in the average.

^cThe prices provided by Hill & Associates were converted from 2003 dollars to 2002 dollars in order to be consistent with AEO2004.

Btu = British thermal unit. NA = Not available.

Sources: **AEO2004:** AEO2004 National Energy Modeling System, runs AEO2004.D101703E (reference case), LM2004.D101703A (low economic growth case), and HM2004.D101703A (high economic growth case). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (July 2003). **Hill & Associates:** Hill & Associates, Inc., *The Outlook for U.S. Steam Coal: Long-Term Forecast to 2022* (August 2003).

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EVA and Hill & Associates, Inc. The *AEO2004* reference case does not anticipate when and how new environmental requirements may take effect, whereas the other forecasts may represent such assumptions. For instance, although *AEO2004* does represent the provisions of the State implementation plan (SIP) call for 19 States where NO_x caps have been finalized, it does not include revised limits on emissions of particulates, because no specific plan is yet in place. Hill & Associates assumes a 21-State SIP call in effect by 2005 and also assumes further reductions of allowable SO₂ levels—4.35 million tons by 2010—in accordance with expectations of future restrictions on particulate emissions. EVA assumes that legislation similar to Clear Skies (including further restrictions on SO₂, NO_x, and mercury) will be in effect by 2010. EVA's forecast also includes a \$5 per ton fee on carbon dioxide emissions beginning in 2013. Neither Hill & Associates nor *AEO2004* represents mercury or carbon dioxide reductions in its reference case.

Given the more restrictive assumptions of the EVA forecast, it is not surprising that *AEO2004* projects higher coal consumption levels than EVA in 2015, 2020, and 2025. *AEO2004* also projects higher coal consumption levels than Hill & Associates, which may be explained partly by Hill & Associate's assumption of additional restrictions on SO₂ emissions. *AEO2004* and EVA show an increase in coal production and consumption from 2002 to 2025, whereas the Hill & Associates forecast remains fairly flat through 2020 (and does not extend to 2025).

The *AEO2004* reference case projects a decline in real coal prices from 2002 to 2015 and 2020, followed by a small increase from 2020 to 2025 (Table 33). Hill & Associates projects average minemouth prices—excluding coking coal and exports—that are roughly the same as projected in the *AEO2004* reference case in 2015 and 3 cents per million Btu lower in 2020. The slightly higher minemouth prices projected in *AEO2004*, relative to Hill & Associates, may be due in part to the higher production levels projected in *AEO2004*. The EVA forecast of national average minemouth prices, lower than the 2002 minemouth price, varies little between 2015 and 2020 and increases by less than 1 percent (based on short tons) from 2020 to 2025.

As western production makes further inroads into markets traditionally served by eastern coal, the average heat content of the coals produced and consumed will drop as well, reflecting the lower thermal content per ton of western coals. The *AEO2004* and EVA forecasts indicate similar average heat contents (calculated by dividing dollars per ton by dollars per million Btu). The average heat content of coal production in the EVA forecast is roughly 20.6, 20.4, and 20.3 million Btu per ton in 2015, 2020, and 2025, respectively, compared the *AEO2004* reference case projections of 20.3, 20.3, and 20.2 million Btu per ton. Those similarities suggest comparable shares of western production in the two forecasts. In contrast, the average heat content associated with coal production in the Hill & Associates projections for 2015 and 2020 is about 22 million Btu per ton, indicating a relatively larger share of eastern production.

Gross exports of coal represent a small and declining part of domestic coal production. In *AEO2004*, their share of total production is expected to fall from 4 percent in 2002 to roughly 2 percent in 2020 and 1 percent in 2025. Currently, coal is the only domestic energy resource for which exports still exceed imports. All the forecasts project that this will change, and that the United States eventually will import more coal than it exports. Hill & Associates projects the fastest rate of increase in net coal imports, with 20.4 million tons more coal imported than exported in 2015. Both EVA and *AEO2004* project similar levels of net imports in 2025, at 17.8 and 22.7 million tons, respectively. Strong price competition from other exporters and the loss of markets as Europe moves away from coal for environmental reasons are among the causes for the long-term decline in export projections.

The coal forecasts reviewed reflect the uncertainties facing the U.S. coal industry as it simultaneously adapts to the financial pressures arising from increasing environmental restrictions on coal use (both here and in Europe), restructuring of the U.S. electricity generation industry, and increasing competition from the relatively unexploited coalfields of international competitors.